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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In re patent application of

A. Okamoto

Serial No. 09/198,376

Group Art Unit: 3743

Filed: November 24, 1998

Examiner: Flanigan, Allen J.

For: THERMAL CONTROL DEVICE

Assistant Commissioner for Patents
Washington, D.C. 20231

SUPPLEMENT TO APPELLANT'S BRIEF

As referenced in the Appellant's Brief filed under 37 C.F.R. 1.192 on
December 6, 2002, attached hereto is a copy of an English language translation of
Japanese Kokai 1-229800.

Respectfully submitted,

Michael E. Whitham
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PATENT TRADEMARK OFFICE



Japanese Patent Laid-Open Publication No. 1-229800

S P E C I F I C A T I O N

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1. Title of the Invention

Radiator

2. Claims

A radiator characterized in that a radiating board formed of a superconducting material is closely attached to a member of an artificial satellite to which heat is to be transferred.

3. Detailed Description of the Invention

[Industrially Applicable Field]

The present invention relates to a radiator for use in an artificial satellite or similar apparatus to be used in the space.

[Prior Art]

The temperature of an artificial satellite (simply satellite hereinafter) is determined by a degree to which the surface member of the satellite absorbs solar energy and a degree to which it releases thermal energy. To control the temperature of the satellite, the surface member is formed of a material having performance that implements desired temperature. Further, a thermal louver with a specific configuration shown in FIGS. 3(a) and 3(b) is used to positively adjust the temperature of a satellite. The thermal louver is mounted on the surface of a satellite and includes a blade, which will be described later, that selectively opens or closes to vary the amount of radiant heat output from the surface of the satellite and therefore the amount of radiation. There are

shown in FIGS. 3(a) and 3(b) a base plate 1 constituting the surface member of a satellite, the space 2, and a thermal louver 3 including a side frame 3a affixed to the base plate 1 and surrounding the radiation surface 1a of the base plate 1, and a blade 3c angularly movably mounted on the side frame 3a via an actuator 3b. The actuator 3b causes the blade 3c to angularly move in accordance with the temperature of the base plate 1. For example, the actuator 3b may be implemented by a bimetal (not shown) that selectively expands or contracts in accordance with the temperature of the base plate 1. More specifically, when the temperature of the satellite rises, the resulting heat is transferred to the base plate 1 with the result that the actuator 3b causes the blade 3c to move in accordance with the temperature. Consequently, the base plate 1 is exposed to the space 2 and releases heat A due to radiation.

[Problems to Be Solved by the Invention]

A problem with the thermal louver 3 is that the actuator 3b that controls the amount of radiation by opening and closing the blade 3c needs sophisticated adjustment. Further, there is an increasing demand for small-size, light-weight apparatuses to be mounted on a satellite. In this respect, the radiation surface 1a of the base plate 1 cannot be reduced beyond a certain limit, making it impossible to make the structural members of the thermal louver 3 small size and light weight.

[Means for Solving Problems]

A radiator of the present invention is characterized in that a radiating board formed of a superconducting material is closely attached to the member of an artificial satellite to which heat is to be transferred.

[Operation]

The radiation ratio of the superconducting material varies at superconduction transition temperature. Therefore, when the temperature of the radiating board rises above the superconduction transition temperature, the amount of heat radiation and therefore the amount of heat released increases. When the temperature of the member to which heat is to be transferred drops, the amount of heat radiation from the radiating board decreases also.

[Embodiment]

A preferred embodiment of the present invention will be described hereinafter.

FIG. 1 is a sectional side elevation showing a radiator embodying the present invention. FIG. 2 is a graph showing the temperature dependency of the infrared radiation ratio of a superconductor. There are shown in these figures a base plate 11 included in, e.g., an artificial satellite and to which heat is to be transferred, the space 12, and a radiating board 13 for controlling the temperature of the base plate 11. The radiating board 13 is formed of a superconducting material and closely attached to the surface of the base plate 11 on the space 12 side such that heat is surely transferred from the base plate 11. Labeled A is heat radiated.

Assume that the amount of radiation of a radiator is Q , that infrared radiation ratio is ϵ , and that temperature is T . Then, the radiation characteristic of a radiator is generally expressed as:

$$Q \propto \epsilon T^4$$

By varying the infrared radiation ratio ϵ , it is possible to control the amount of radiation Q . Further, as shown in FIG. 2, the infrared radiation ratio $\epsilon(T)$ of a superconductor is dependent on temperature T and noticeably varies particularly around superconduction transition temperature T_c . More specifically, when a superconductor is in a superconduction state because its temperature is lower than the superconduction transition temperature, the infrared radiation ratio $\epsilon(T)$ and the amount of radiation are small. However, when the temperature of the superconductor rises above T_c and brings the superconductor into a usual conduction state, the infrared radiation ratio $\epsilon(T)$ and the amount of radiation increase.

It follows that when heat is transferred to the radiating board 13 due to the temperature elevation of the base plate 11, the amount of radiation remains small until the temperature of the radiating board 13 reaches the superconduction transition temperature T_c . The amount radiation then increases little by little as the temperature rises above T_c . Subsequently, when the base plate 11 is cooled by the radiating board 13, the radiating board again restores the superconduction state, causing a minimum of heat to be radiated from the base plate 11. In this manner, the temperature of the base plate 11 is automatically controlled.

[Effects of the Invention]

As stated above, in accordance with the present invention, a radiating board formed of a superconducting material is closely attached to the member of an artificial satellite to which heat is to be transferred. In this configuration, when

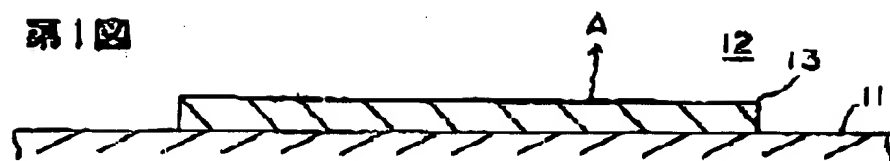
the temperature of the radiating board rises above superconduction transition temperature, the amount of radiation and the amount of heat radiated increase. When the temperature of the member to which heat is to be transferred drops, the amount of radiation from the radiating board decreases, too. In this manner, the temperature of the member to which heat is to be transferred is automatically controlled. Therefore, the radiating board can implement automatic temperature control alone, reducing the weight of the radiator.

4. Brief Description of the Drawings

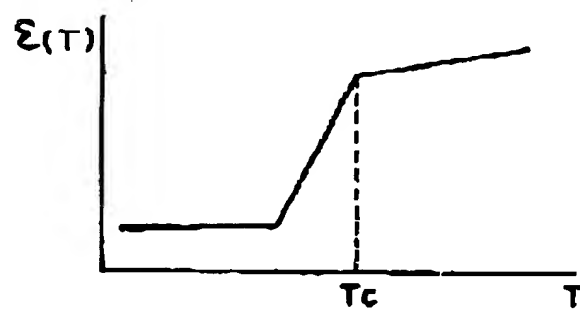
FIG. 1 is a sectional side elevation showing a radiator embodying the present invention, FIG. 2 is a graph showing the temperature dependency of the infrared radiation ratio of a superconductor, and FIGS. 3(a) and 3(b) are a perspective view and a sectional side elevation, respectively showing a conventional thermal louver.

11 ... base plate, 13 ... radiating board.

第1圖



第2圖



第3圖

